That which is claimed is:

1. A flow reactor comprising a plurality of walled conduits each having an outer surface disposed for contact with a heat-transfer medium, an inlet distribution manifold adapted for flow communication with a downstream manifold through channels formed by heterogeneous catalytic material disposed within each conduit during operation in a sequence of zones for catalyst having the same or different length along the longitudinal coordinate of the conduit and within each zone essentially uniform cross-section of the conduit measured in a plane perpendicular to the longitudinal coordinate thereby defining volume of the zone, and the sequence of zones comprising at least two zones such that each downstream zone has a different cross-section than the contiguous upstream zone.

2. The flow reactor according to Claim 1, further comprising a shell adapted to maintain during operation the outer surface of each conduit predominantly in contact with a heat-transfer medium, and having an inlet in flow communication with an outlet for the heat-transfer medium.

3. The flow reactor of claim 1, wherein the cross section and length of each zone are sized so that the heat generated during any exothermic reactions occurring inside the conduits of the zone does not exceed the amount of heat capable of being transferred to and removed by the heat transfer medium surrounding the conduits.

4. The flow reactor according to Claim 1, wherein the sequence of zones comprises at least three zones.

5. The flow reactor according to Claim 1, wherein that each downstream zone has a larger cross-section than the contiguous upstream zone.

6. The flow reactor according to Claim 1, wherein each downstream zone has a larger volume than the contiguous upstream zone.

7. The flow reactor according to Claim 1, wherein cross-section of the conduit in each zone has a substantially circular form with a diameter such that the third power of the diameter is equal to the product of the volume and a geometric factor having values in a range from about 0.01 to about 0.50.

8. The flow reactor according to Claim 7, wherein the geometric factor of each downstream zone is larger than the contiguous upstream zone for the sequence of zones comprising at least three zones.

9. The flow reactor according to Claim 1, wherein the zones for catalyst have a total length along the longitudinal coordinate of at least 4 meters.

10. The flow reactor according to Claim 7, wherein the cross-section of the conduit in each zone has a substantially circular form with a diameter such that the third power of the diameter is equal to the product of the volume and a geometric factor having values in a range from about 0.015 to about 0.100.

11. The flow reactor according to Claim 10, wherein the geometric factor of each downstream zone is larger than the contiguous upstream zone for the sequence of zones comprising at least three zones.

12. A flow reactor comprising:

(i) a plurality of walled conduits each having an outer surface disposed for contact with a heat-transfer medium,

(ii) an inlet distribution manifold adapted for flow communication with a downstream manifold through channels formed by heterogeneous catalytic material disposed within each conduit during operation,

(iii) a sequence of zones comprising at least two zones, said zones comprising said walled conduits, wherein

(a) the walled conduits within each zone have the same or different length measured along the longitudinal coordinate of the zone,

(b) the walled conduits within each zone have essentially uniform cross-section measured in a plane perpendicular to the longitudinal coordinate thereby defining volume of the zone, and

(c) in the sequence of zones, the total cross-sectional area of the conduits in each downstream zone varies from the prior upstream zone,

(iv) at least one crossover chamber in flow communication with the plurality of walled conduits of a downstream zone and the plurality of walled conduits of the prior upstream zone,

(v) a shell adapted to maintain during operation the outer surface the plurality of walled conduits of each zone predominantly in contact with a heat-transfer medium, and

(vi) the shell having an inlet in flow communication with an outlet for flow of the heat-transfer medium.

13. The flow reactor of claim 12, wherein the cross section and length of each zone are sized so that the heat generated during any exothermic reactions occurring inside the conduits of the zone does not exceed the amount of heat capable of being transferred to and removed by the heat transfer medium surrounding the conduits.

14. The flow reactor according to Claim 12, wherein the sequence of zones comprises at least three zones.

15. The flow reactor according to Claim 12, wherein that each downstream zone has a larger cross-section than the contiguous upstream zone.

16. The flow reactor according to Claim 12, wherein each downstream zone has a larger volume than the contiguous upstream zone.

17. The flow reactor according to Claim 12, wherein at least one crossover chamber has an inlet in flow communication with the plurality of walled conduits of a downstream zone.

18. The flow reactor according to Claim 12, further comprising, a shell adapted to maintain during operation the outer surface of each conduit predominantly in contact with a heat-transfer medium, and having an inlet in flow communication with an outlet for the heat-transfer medium.

19. The flow reactor according to Claim 18, wherein cross-section of the conduit in each zone has a substantially circular form with a diameter such that the third power of the diameter is equal to the product of the volume and a geometric factor having values in a range from about 0.01 to about 0.50.

20. The flow reactor according to Claim 18, wherein the geometric factor of each downstream zone is larger than the contiguous upstream zone for the sequence of zones comprising at least three zones.

21. The flow reactor according to Claim 12, wherein the zones for catalyst have a total length along the longitudinal coordinate of at least 4 meters.

22. The flow reactor according to Claim 12, wherein the cross-section of the conduit in each zone has a substantially circular form with a diameter such that the third power of the diameter is equal to the product of the volume and a geometric factor having values in a range from about 0.015 to about 0.100.

23. The flow reactor according to Claim 22, wherein the geometric factor of each downstream zone is larger than the contiguous upstream zone for the sequence of zones comprising at least three zones.

24. A process which includes exothermic chemical conversions of organic compounds to value added products using a selective heterogeneous catalyst in at least one flow reactor comprising a plurality of walled conduits each having an outer surface disposed for contact with a heat-transfer medium, an inlet distribution manifold adapted for flow communication with a downstream manifold through channels formed by heterogeneous catalytic material disposed within each conduit during operation in a sequence of zones having the same or different length along the longitudinal coordinate of the conduit and within each zone essentially uniform cross-section of the conduit measured in a plane perpendicular to the longitudinal coordinate thereby defining volume of the zone, and the sequence of zones comprising at least two zones such that each downstream zone has a different cross-section than the contiguous upstream zone.

25. The process according to Claim 24, wherein the sequence of zones in the flow reactor comprises at least three zones.

26. The process according to claim 24, wherein the cross section and length of each zone in the flow reactor are sized so that the heat generated during any exothermic reactions occurring inside the conduits of the zone does not exceed the amount of heat capable of being transferred to and removed by the heat transfer medium surrounding the conduits.

27. The process according to Claim 24, wherein that each downstream zone in the flow reactor has a larger cross-section than the contiguous upstream zone.

28. The process according to Claim 24, wherein that each downstream zone in the flow reactor has a larger volume than the contiguous upstream zone.

29. The process according to Claim 24 wherein the exothermic chemical conversions of organic compounds to value added products comprises oxidation of benzene or a hydrocarbon selected from the group consisting of n-butane, butene-1 and butadiene, to form maleic anhydride.

30. The process according to Claim 24 wherein the exothermic chemical conversions of organic compounds to value added products comprises oxidation of

n-butane to form maleic anhydride by contacting n-butane at low concentration in an oxygen-containing gas with a fixed catalyst comprising principally tungsten, phosphorus and oxygen.

31. The process according to Claim 24 wherein the catalyst is maintained at a temperature in a range from about 360°C to about 530°C.

32. The process according to Claim 24 wherein the cross-section of each downstream zone which has a larger cross-section than the cross-section of the contiguous upstream zone is larger by an amount such that during operation temperatures of the exotherm as measured along the centerline are no more than 50°C higher than the heat-transfer medium temperature.